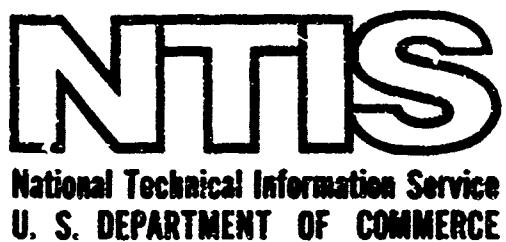AD-A012 847

COMPUTER PROGRAM FOR PREDICTING CASUALTIES AND DAMAGE
FROM ACCIDENTAL EXPLOSIONS

T. A. Zaker

Department of Defense Explosives Safety Board
Washingtcn, D. C.

May 1975

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COMPUTER PROGRAM FOR PREDICTING CASUALTIES

AND DAMAGE FROM ACCIDENTAL EXPLOSIONS

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD

May 1975

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A computer program has been prepared in Fortran language for calculating expected numbers of casualties by blast and fragment injury in a population of unprotected persons, and damage to unstrengthened residential buildings by blast from explosions. The program generates tables of injury probability, percent casualties, and percent building damage as functions of distance from block stacks of mass-detonating bombs and projectiles described in the input data.

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COMPUTER PROGRAM FOR PREDICTING CASUALTIES AND DAMAGE

FROM ACCIDENTAL EXPLOSIONS

Technical Paper 11

Department of Defense Explosives Safety Board

Washington, D. C.

May 1975

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FOREWORD

This paper was prepared by the Technical Programs Division, Department of Defense Explosives Safety Board, in response to the need for techniques for rapidly estimating blast and fragment hazards for specific ammunition storage situations. The paper draws extensively upon weapons effects data compiled by the Board staff and its contractors, as indicated by the literature cited. It is hoped that the paper will be of value to those concerned with analyzing the potential effects of accidental explosions of stored ammunition when normal quantity-distance standards cannot be met.

P. F. KLEIN
Captain, USN
Chairman

May 1975

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PREFACE

A computer program has been prepared in Fortran language for calculating expected numbers of casualties by blast and fragment injury in a population of unprotected persons, and damage to un-strengthened residential buildings by blast from explosions. The program generates tables of injury probability, percent casualties, and percent building damage as functions of distance from block stacks of mass-detonating bombs and projectiles described in the input data.

The program is based on simple representations of explosion effects data current at the time of this publication. Although injury and damage mechanisms due to explosive blast are considered rather well understood, estimates of fragment effects are based on extrapolation of single-weapon test data to large numbers of weapons and long distances from the explosion source. The code, however, can be readily modified by appropriate substitution of improved treatments of injury mechanisms in the program, or better characterization of weapon properties in input data, as they become available.

While the results do not reduce the need for strict compliance with published explosives safety standards, they may be of assistance in evaluating the protection afforded by the standards and in assessing the risks connected with deviations from them when waiver or exemption requests are evaluated or granted.

CONTENTS

ILLUSTRATIONS

COMPUTER PROGRAM FOR PREDICTING CASUALTIES
AND DAMAGE FROM ACCIDENTAL EXPLOSIONS

INTRODUCTION

This paper describes a computer program for calculating expected
numbers of casualties from blast and fragments in a population of
unprotected persons, and damage to typical unstrengthened residential
buildings by blast, as functions of distance from hypothetical accidental
explosions of regular stacks of mass-detonating bombs and projectiles.
In what follows explosive blast and fragmentation effects data which
form the basis for calculations performed by the code are summarized.
Procedures utilized in the code for computing probabilities of human
injury or fatality from the combined effects of blast and fragments are
discussed. Input data format, program operation, and typical results
are described. A Fortran listing of the code is appended, together with
a sample output table for a particular case.

EXPLOSION SOURCE FUNCTIONS

Blast and fragment effects are calculated from the equations of
curves fitted to data on these effects as functions of distance from
the source. Blast effects are referenced to a bare TNT hemisphere on a
flat ground surface.

Blast Effects

Blast parameters which determine human injury and wood-frame house
damage are the overpressure, the impulse of the dynamic (blast wind)
pressure wave, and to a minor degree explicitly, the wave duration.

These parameters all depend on distance scaled by the cube root of the weight of the equivalent TNT hemisphere. Damage to certain types of buildings such as large, massive structures, which may be a function of the impulse of the overpressure wave, is not treated, nor are close-in (very high pressure) effects or the localized effects of small charges.

In the computer program for casualty and damage prediction, the effective charge weight is obtained by adjusting the total net explosive weight by factors which account for the TNT equivalence of the explosive and for the suppressing effect of metal case material and magazine earth cover, if either or both are present, on explosive blast.[1]*

The case effect is accounted for by applying a factor F which depends on the metal-to-charge weight ratio M/C in the following way[2]:

$$F = 0.6 + 0.4/(1 + 2M/C)$$

In this expression, C is taken to be the TNT equivalent of the filler explosive weight in the weapon.

The effect of the earth cover of a magazine depends on the cover-to-charge ratio. For simplicity the single numerical value of 0.8, derived from test data for a standard igloo containing 100,000 lb of explosive, is applied to the explosive weight in earth-covered storage. Finally, a factor of 1.2 is applied to account for the enhancement of blast in the directions perpendicular to the faces of rectangular stacks. This value has been found to be a suitable average for nearly cubical stacks.[1]

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* Superscript numerals designate appended references

With distance R scaled by the cube root of the weight W of the effective TNT hemisphere, the peak overpressure p is calculated from a ninth-order polynomial fit of its logarithm to $\log(R/W^{1/3})$, due to Romesberg.[3] Alternatively, a similar eighth-order fit given by Kingery[4] could be used.

The scaled dynamic overpressure impulse per unit area, $J/W^{1/3}$, is represented as a one-term power-law function of scaled distance adapted by Fugelso et al.[1] from Richmond and Fletcher.[5] Finally, the scaled positive phase duration, $t_d/W^{1/3}$, is also expressed as a one-term power-law function of scaled distance developed by Fugelso et al.[1]

Fragment Density

Fragment density (number per unit area) is calculated as a suitable multiple of that from the sidespray of a single weapon. The results of Feinstein[6] for single weapons, obtained as a function of distance by considering the effects of atmospheric drag and gravity on fragment trajectories, using as initial data the velocities and weight distributions determined in weapon effectiveness tests, serve as the basis. The single-weapon density profiles so determined, for all fragments and for fragme ° of energy exceeding 58 ft-lb at impact, are represented by piecewise linear approximations of the logarithm of fragment density as a function of distance. The approximation for heavy fragments consists of two straight lines, while for some weapons the approximation for all fragments requires three segments. As will be noted later, the junction points in the piecewise linear representations are identified by the distances at which specified levels of fragment density occur from single weapons.

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In applications to stacks of weapons, the single-weapon density profiles are multiplied by the number of units on the side or end of the stack considered to be the controlling orientation. No distinction is made between weapons stored aboveground and under earth cover. Empirical rules have, however, recently been suggested which might be incorporated into the code to improve the treatment of fragments from weapon stacks.[7]

INJURY AND DAMAGE FUNCTIONS

Personnel injury and building damage are computed from blast pressure and impulse and from fragment density, all as functions of distance from the explosion. Probabilities of injury exceeding each of two levels are considered: severe injury or fatality, and injury of any severity, however slight.

Blast Injury

Human injury from blast may be one of three types: primary, due to the overpressure of the blast wave alone; secondary, from impact by debris from damaged structures; and tertiary, by striking the ground surface or a stationary object after acceleration by blast forces.

Damage to the lungs is taken to be indicative of primary blast injury of a serious level. It is a function of blast overpressure alone, except for a weak dependence on wave duration.[8] The probability of severe or fatal injury is calculated from a cumulative lognormal distribution with respect to the pressure (that is, from a standard error function of the logarithm of pressure) centered at 20.5 psi for waves of very long duration, with 1- and 99-percent levels at 14.5 and 29.0 psi, respectively.

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Eardrum damage is the farthest-reaching primary effect of blast on personnel. It is a function of overpressure only,[1,5] and is calculated from a lognormal distribution centered at 6.3 psi, with 10- and 90-percent levels at 3.2 and 12.2 psi.

Secondary effects of blast on personnel, from impact by building debris, will depend strongly on the extent of damage to structures. As a result, the risk to occupants can at best only be inferred qualitatively from building damage calculations. On the other hand, displacement (tertiary) effects can be estimated for persons assumed to be without protection from the dynamic pressure impulse.[1] Serious head injury is assumed to occur in 50 percent of cases of impact at 18 ft/sec. This corresponds to an applied impulse of 75.2 psi-msec. The distribution is normal, with 1- and 99-percent levels at 54.3 and 96.1 psi-msec. A marginal level of injury by this same mechanism is assumed to occur in 50 percent of exposures at 2 ft/sec (8.3 psi-msec), with a normal distribution having 1- and 99-percent levels at 1.25 and 15.35 psi-msec, respectively.[5]

Fragment Injury

The probability P of a strike by one or more fragments is calculated from formulas of the form

$$P = 1 - \exp(-qA)$$

where q is the fragment density and A is the exposed vulnerable area of the individual. For calculations of severe injury probability, the density of fragments of impact energy exceeding 58 ft-lb is used in the formula,

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with area $A = 6.2$ ft^2, corresponding to the area of a person facing the explosion and taking no evasive action.[5] For calculations of all fragment injury, however slight, the density of all fragments is used with an area of 8.0 ft^2, the silhouette area of a standing man.[9] The former value of A is considered to be the area susceptible to serious injury by heavy fragments, while the latter value includes body extremities as well.

Casualty Probabilities

Compound probabilities P_c are calculated for severe or fatal injury, and for all injury, by combining the probabilities of direct blast injury, displacement injury, and fragment injury in formulas of the type

$$P_c = 1 - (1-P_1)(1-P_2)(1-P_3)$$

where P_1, P_2, and P_3 are the probabilities of injury by the independent mechanisms operating. The result, multiplied by 100, represents the percentage of casualties in a population exposed at a given distance from the explosion.

Building Damage

Damage to unstrengthened single-family dwellings in several exposures to test explosions has been assessed quantitatively by Wilton.[10] He found that the level of damage, expressed as a percentage of building value, depends on overpressure alone. The results are well approximated by a cumulative normal distribution centered at 3.8 psi, with 15- and 85-percent levels at 2.1 and 5.5 psi.

COMPUTER PROGRAM

In an effort to provide, in easily understood tabular form, overall blast and fragment estimates for specific ammunition storage situations, a computer program was prepared in Fortran language incorporating injury and damage functions discussed in the preceding sections of this paper. The program generates tables of numbers of casualties and building damage listed as functions of distance from 100 to 10,000 ft divided into approximately 50 intervals.

The code consists of a main program, two function subprograms, and a block data subprogram. Significant steps in the main program, identified by line numbers in the appended listing, are discussed below.

Line 2:   Storage space is allocated for array variables containing descriptive information regarding munition stack shape (SS) and the format of numerical output (FMT).

Lines 3-7:   Functions are defined which describe the logarithm of fragment density as piecewise linear with respect to distance from a single munition.

Lines 8-13:   Probability units are defined for dynamic overpressure impulse, for the overpressure, and for the logarithm of overpressure, to be used later in calculating injury and damage levels with assumed cumulative normal distributions.

Lines 14-15:   A logarithmic increment of distance is defined for later use.

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Line 17: Weapon name, gross weight, weight of explosive per unit, TNT equivalence of the filler, and characteristic fragment distances from a single munition are read in.

Line 19: Total explosive weight, earth factor (1.0 or 0.8), number of units on the end of the stack, stack shape, and stack length in unit diameters are read in.

Line 20: If stack length is nonzero in input data, the stack is assumed to be prismatic, and the actual total filler weight is computed. Otherwise the value WE supplied in input data is used.

Lines 21-28: Problem definition and table headings are written.

Lines 29-31: The modified Fano case factor[2] and the effective TNT weight and its cube root are calculated.

Lines 32-33: Distance is initialized at 100 ft.

Lines 34-37: Scaled distance, overpressure, duration and dynamic overpressure impulse are calculated. The function subprogram for overpressure is based on a ninth-degree polynomial fit.[3]

Lines 38-40: Probabilities of serious head and lung injury are calculated from cumulative normal and lognormal distributions. The error function subprogram is based on a rational approximation given in Abramowitz and Stegun's (1964) NBS Handbook of Mathematical Functions.[11]

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Line 41:   The probability of blowdown with slight injury is computed

based on threshold and 50-percent levels suggested by

Richmond.[5]

Line 42:   The probability of ear injury (considered not a severe

lesion) is calculated from a cumulative normal distribution

with respect to the logarithm of overpressure.

Line 43:   The probability of primary blast injury is obtained by

compounding ear and lung injury probabilities.

Lines 44-56:   The density (Q) of fragments of impact energy greater

than 58 ft-lb, and the density (QA) of all fragments, are

calculated unless the fragment distance parameter X3 has

not been supplied as input. Q is defined as bilinear in

semilogarithmic coordinates, and QA as either bilinear or

trilinear, coinciding with Q at distances greater than X3.

The piecewise linear approximations for the 155mm projectile

with base down, shown in Figure 1, are typical. At the

distances X0, X1,..., X4 supplied in input data, the fragment

density from a single weapon has values which are specified

to be multiples of $(1/600)$ ft^{-2} by factors of $10^{1/3}$ in the

arithmetic statement function definitions, lines 3-7.

Lines 58-59:   The probabilities of impact by heavy fragments and by

all fragments on the presented area of an individual facing

the explosion are calculated from Poisson statistics. The

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former represents severe injury or death, while the latter

is an upper bound intended to represent all fragment injury,

however slight.

Lines 60-61: Serious injuries per 100 population, and all injuries,

are calculated by compounding the appropriate probabilities.

Line 62: Damage in percent of building value is calculated from a

cumulative normal distribution with respect to overpressure

centered at 3.8 psi. This combines structural and super-

ficial damage, and is an excellent fit of data compiled by

Wilton.[10]

Line 63: Results are written in formats specified at program execution

time (line 16). The formats (1H0, F8.0, F9.2,2(3F10.2,

F10.0),F10.0) and (1H0,F8.0,4F10.3,F10.1,3F10.3,2F10.1)

have been used for 2- and 3-place precision in output.

Lines 64-69: The running distance variable X is increased by a

constant logarithmic increment, and R is the next lower

integer multiple of 10 ft, not exceeding the table range of

10,000 ft. A coarser table, with values of R being multiples

of 100 ft, is obtained if one replaces line 67 with the statement

R = 100*IFIX(X/100.).

A sample table of output data at 2-place precision is appended with

the program listing. Two data cards are required to generate each such

table. In addition, the first data card of the deck must specify output

format for an entire job.

The tabulated results may be used directly if desired, or they may be plotted and used graphically. Curves of injury and damage for approximately 250,000 lb of tritonal in 750-lb bombs are shown in Figure 2. The results of a number of cases may be cross-plotted to determine the relations between, say, explosive quantity and distance. An example is given in Figure 3, where such curves are shown for two types of weapons at the 10 percent level of serious injury or fatality.

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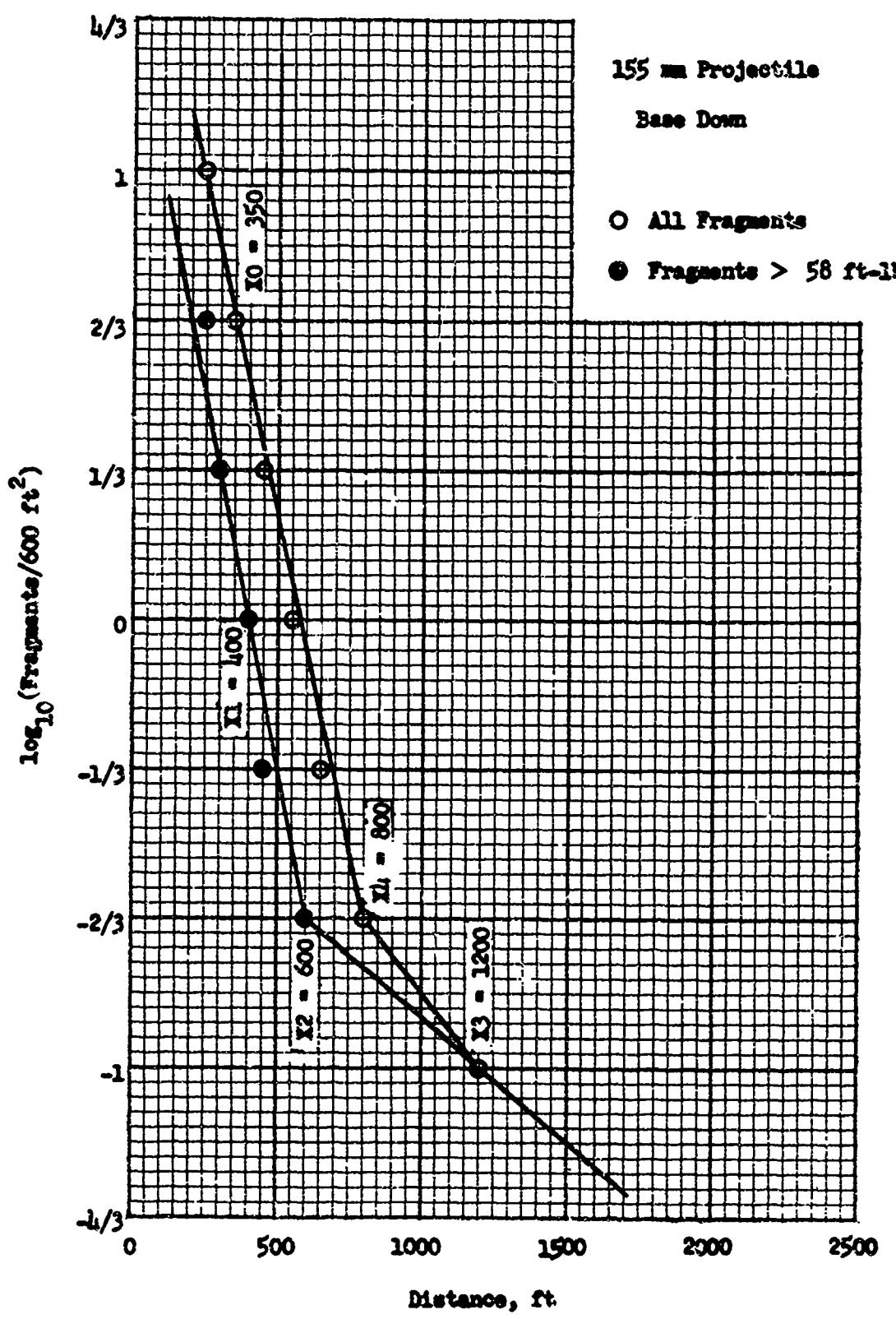
Figure 1   Fragment Density for a Single Weapon

13
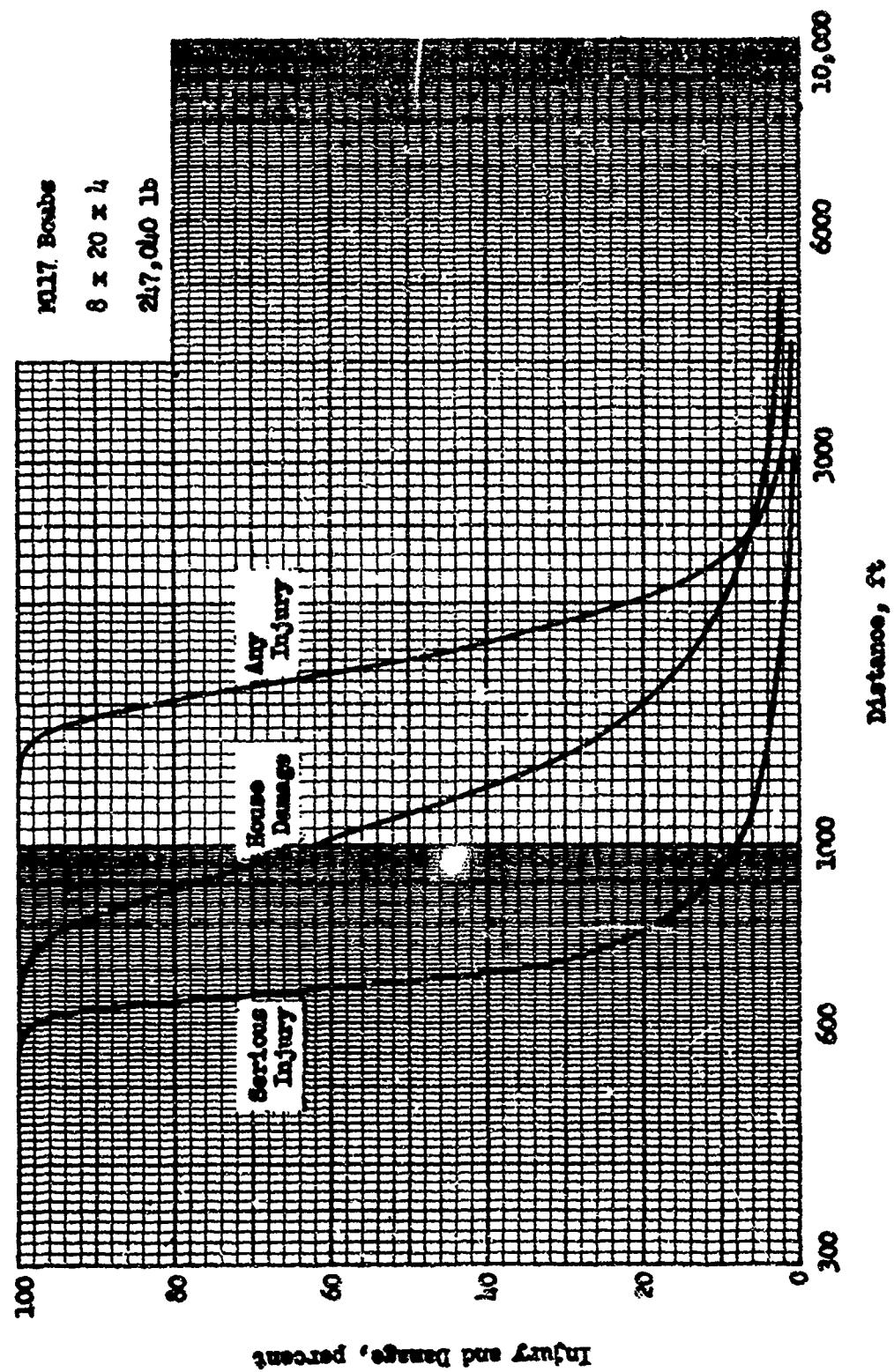
Figure 2 Computed Effects from a Stack of Bombs

M117 Bombs
8 x 20 x 4
247,040 lb

Any Injury

House Damage

Serious Injury

Distance, Ft

Injury and Damage, percent

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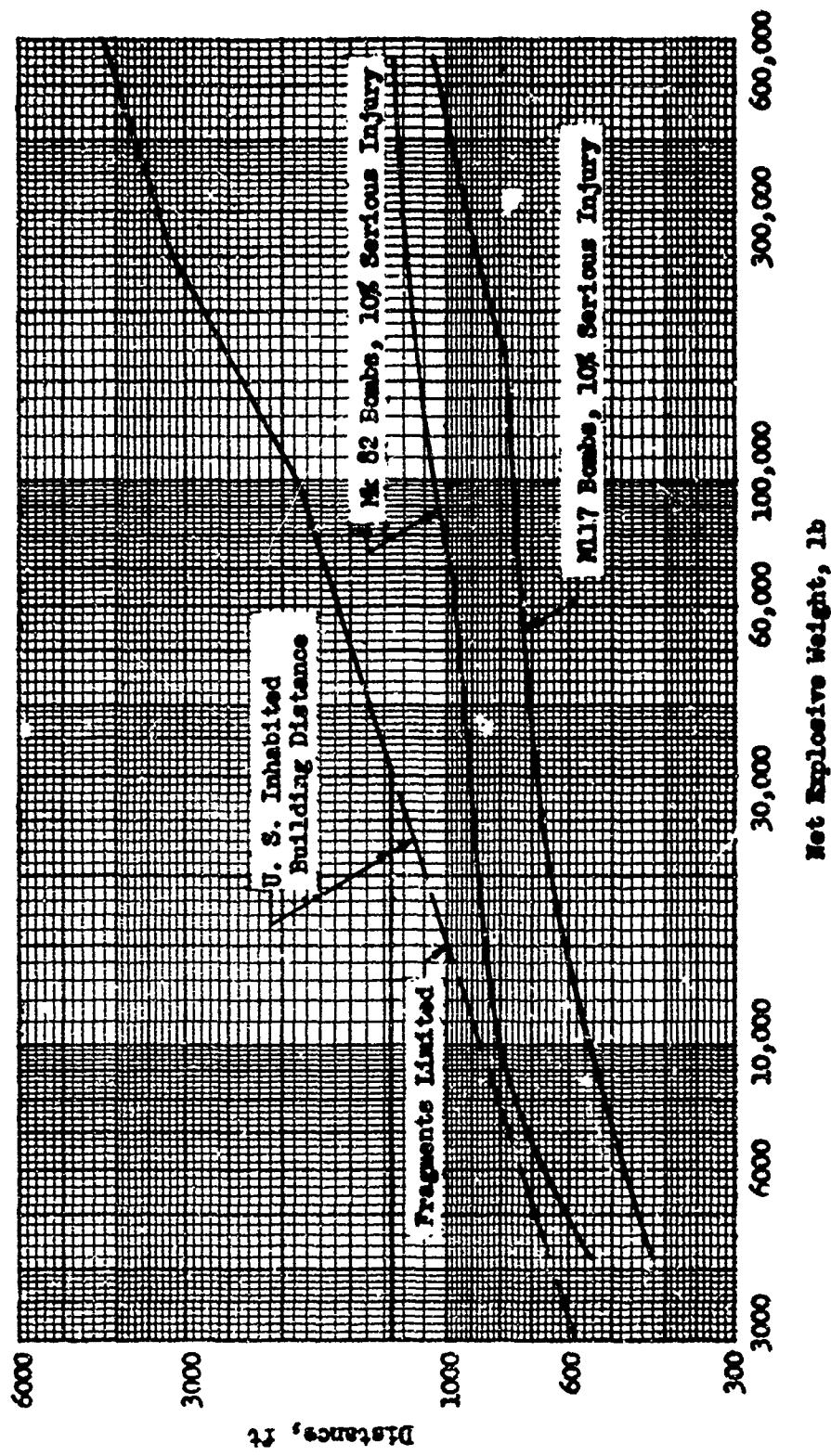
Figure 3 Distances for a Specific Injury Level Compared with Standards

The figure axes and labels (read from the rotated plot):

- X-axis: Net Explosive Weight, lb — values: 3000, 6000, 10,000, 30,000, 60,000, 100,000, 300,000, 600,000
- Y-axis: Distance, ft — values: 300, 600, 1000, 3000, 6000

Curve labels:
- Mk 82 Bombs, 10% Serious Injury
- XM17 Bombs, 10% Serious Injury
- U. S. Inhabited Building Distance
- Fragments Limited

```
      PROGRAM CASDAM(INPUT,OUTPUT,TAPE60=INPUT,TAPE61=OUTPUT)
      DIMENSION SS(2),FMT(8)
      Q12(X) = 10.**(2.*(X-X2)/(3.*(X1-X2))-8./3.)/6.
      Q23(X) = 10.**(   (X-X2)/(3.*(X2-X3))-8./3.)/6.
      Q03(X) = 10.**(5.*(X-X3)/(3.*(X0-X3))-3.)/6.
      Q04(X) = 10.**(4.*(X-X4)/(3.*(X0-X4))-8./3.)/6.
      Q43(X) = 10.**(   (X-X4)/(3.*(X4-X3))-8./3.)/6.
      SQRT2 = SQRT(2.)
      SDJ2 = SQRT2    *41.8/4.653
      SDJ2T = SQRT2   *7.05/2.327
      SDLP2 = SQRT2   *ALOG(29.0/14.5)/4.653
      SDLP2E = SQRT2  *ALOG(12.2/6.3)/1.282
      SDP2 = SQRT2    *3.4/2.073
      SPC = 25.
      DLX1 = 10.**(1./SPC)+1.E-7
      READ(60,100) FMT
    1 READ(60,101) WPN,WGR,WEU,TEQ,X1,X2,X3,X0,X4
      IF(EOF(60).NE.0.) STOP
      READ(60,102) WE,EF,BS,SS,SW
      IF(SW.GT.0.) WE = BS*SW*WEU
      IW = WE
      IB = BS
      IE = 5.-4.99*EF
      WRITE(61,201) WPN,IW,TEQ,IB,IE,SS
      WRITE(61,202)
      WRITE(61,203)
      WRITE(61,204)
      WRITE(61,205)
      FF = 0.6+0.4/(1.+2.*(WGR-WEU)/(TEQ*WEU))
      WEV = 1.2*WE*TEQ*FF*EF
      CRTW = WEF**(1./3.)
      X = 100.
      R = X
    2 Z = R/CRTW
      PR = PRF(Z)
      TD = 1.188*CRTW*Z**0.5473
      XJ = 266.449*CRTW/Z**2.3201
      PHD = (1.+ERF((XJ-75.2)/SDJ2))/2.
      PMTD = 20.5*(1.+6.76/TD**1.064)
      PLG = (1.+ERF(ALOG(PR/PMTD)/SDLP2))/2.
      PIG = (1.+ERF((XJ-8.3)/SDJ2T))/2.
      PER = (1.+ERF(ALOG(PR/6.3)/SDLP2E))/2.
      PWI = 1.-(1.-PER)*(1.-PLG)
      Q = 0.
      QA = 0.
      IF(X3.LE.0.) GO TO 3
      IF(R.LT.X2) Q = BS*Q12(R)
      IF(R.GE.X2) Q = BS*Q23(R)
      QA = 0
      IF(R.GE.X3) GO TO 3
      IF(X4.GT.0.) GO TO 5
      QA = BS*Q03(R)
      GO TO 3
    5 CONTINUE
      IF(R.LT.X4) QA = BS*Q04(R)
      IF(R.GE.X4) QA = BS*Q43(R)
    3 CONTINUE
```

```fortran
      PFR = 1.-EXP(-6.2*Q)
      PAF = 1.-EXP(-8.0*QA)
60    PCTC = 100.*(1.-(1.-PHD)*(1.-PLG)*(1.-PFR))
      PCTAC = 100.*(1.-(1.-PIG)*(1.-PBI)*(1.-PAF))
      PCTD = 100.*(1.+ERF((PR-3.8)/SDP2))/2.
      WRITE(61,FMT) R,Z,PHD,PLG,PFR,PCTC,PIG,PBI,PAF,PCTAC,PCTD
      RO = R
65  4 CONTINUE
      X = DLX1*X
      R = 10*IFIX(X/10.)
      IF(R.LE.RO) GO TO 4
      IF(R.GT.1.E4) GO TO 1
70    GO TO 2
  100 FORMAT (8A10)
  101 FORMAT (A8,6F10.0,2F6.0)
  102 FORMAT (3F10.0,2A8,F10.0)
  201 FORMAT (1H1,A8,I10  ,9H LB HE ATF5.2,8H TNT EQ,I4  .24H SIDE UNITS
75   1, EARTH COVERI2,14H, STACK SHAPE 2A8)
  202 FORMAT (1H0,28X,16HPROBABILITIES OF,8X,7HPERCENT,9X,16HPROBABILITI
     1ES OF,8X,7HPERCENT)
  203 FORMAT (1H ,25X,22HSEVERE OR FATAL INJURY,5X,7HSERIOUS,6X,22HANY I
     1NJURY OR FATALITY,7X,3HANY,5X,7HPERCENT)
80  204 FORMAT (1H ,4X,4HDIST,4X,6HSCALED,5X,4HHEAD,6X,4HLUNG,6X,5HHEAVY,
     13X,6H  INJURY,3X,6HGROUND,5X,5HBLAST,6X,3HALL,6X,6HINJURY,2X,8HBUI
     2LDING)
  205 FORMAT (1H ,4X,4H(FT),5X,4HDIST,5X,6HINJURY,3X,8HCOLLAPSE,2X,9HFRA
     1GMENTS,2X,8HOR DEATH,2X,6HIMPACT,4X,6HINJURY,3X,9HFRAGMENTS,2X,8HO
85   2R DEATH,2X,6HDAMAGE)
      END
```

```fortran
      FUNCTION PRF(Z)
      COMMON/OV/OP(10)
      ZL = ALOG(Z)
      SUM = OP(10)
5     DO 1 I = 1,9
      IN = -I
1     SUM = SUM*ZL+OP(IN+10)
      PRF = EXP(SUM)
      RETURN
10    END




      FUNCTION ERF(X)
      COMMON/ER/A(5)
      AX = X
      IF(X.LT.0.) AX = -X
5     SUM = A(5)
      DO 1 I = 1,4
      IN = -I
1     SUM = SUM*AX+A(IN+5)
      ERF = 1.-1./SUM**4
10    IF(X.LT.0.) ERF = -ERF
      RETURN
      END




      BLOCK DATA
      COMMON/OV/OP(10)
      COMMON/ER/A(5)
      DATA OP/.703681E1,-.1663724E1,-.2516481,-.1137714,.3818405E-1,
5    1     .5035198E-1,-.275497E-1,.5557968E-2,-.5108014E-3,.1795565E-4/
      DATA A/1.,.278393,.230389,.000972,.078108/
      END
```

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MARK F2   100000 LB HE AT 1.25 TNT EQ, 26 SIDE UNITS, EARTH COVER 0, STACK SHAPE 8 X 12 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.11	1.00	1.00	.99	100.	1.00	1.00	1.00	100.	100.
120.	2.53	1.00	1.00	.99	100.	1.00	1.00	1.00	100.	100.
130.	2.74	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
140.	2.95	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
150.	3.16	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
170.	3.58	1.00	1.00	.97	100.	1.00	1.00	1.00	100.	100.
190.	4.00	1.00	1.00	.96	100.	1.00	1.00	1.00	100.	100.
200.	4.22	1.00	1.00	.96	100.	1.00	1.00	1.00	100.	100.
220.	4.64	1.00	1.00	.95	100.	1.00	1.00	1.00	100.	100.
250.	5.27	1.00	1.00	.93	100.	1.00	1.00	1.00	100.	100.
270.	5.69	1.00	.96	.91	100.	1.00	1.00	1.00	100.	100.
300.	6.32	1.00	.76	.88	100.	1.00	1.00	1.00	100.	100.
330.	6.95	1.00	.25	.85	100.	1.00	.99	1.00	100.	100.
360.	7.59	1.00	.03	.81	100.	1.00	.97	1.00	100.	100.
390.	8.22	.99	.00	.78	100.	1.00	.94	1.00	100.	100.
430.	9.06	.54	.00	.72	87.	1.00	.67	1.00	100.	100.
470.	9.91	.07	.00	.66	69.	1.00	.79	.99	100.	100.
520.	10.96	.00	.00	.59	59.	1.00	.67	.98	100.	99.
570.	12.01	.00	.00	.52	52.	1.00	.55	.95	100.	96.
630.	13.28	.00	.00	.44	44.	1.00	.42	.88	100.	88.
690.	14.54	.00	.00	.37	37.	1.00	.31	.78	100.	75.
750.	15.81	.00	.00	.30	30.	1.00	.23	.65	100.	62.
830.	17.49	.00	.00	.23	23.	1.00	.15	.49	100.	37.
910.	19.18	.00	.00	.18	18.	.95	.09	.35	97.	36.
1000.	21.08	.00	.00	.13	13.	.79	.06	.20	85.	27.
1090.	22.97	.00	.00	.09	9.	.56	.03	.14	66.	21.
1200.	25.29	.00	.00	.06	6.	.38	.02	.08	48.	16.
1310.	27.61	.00	.00	.04	4.	.20	.01	.05	24.	13.
1440.	30.35	.00	.00	.02	2.	.11	.01	.03	14.	10.
1580.	33.30	.00	.00	.01	1.	.06	.00	.01	8.	8.
1720.	36.46	.00	.00	.01	1.	.04	.00	.01	5.	7.
1900.	40.04	.00	.00	.00	0.	.03	.00	.00	3.	6.
2080.	43.84	.00	.00	.00	0.	.02	.00	.00	2.	5.
2290.	48.26	.00	.00	.00	0.	.01	.00	.00	1.	4.
2510.	52.90	.00	.00	.00	0.	.01	.00	.00	1.	4.
2750.	57.96	.00	.00	.00	0.	.01	.00	.00	1.	3.
3010.	63.44	.00	.00	.00	0.	.01	.00	.00	1.	3.
3310.	69.76	.00	.00	.00	0.	.01	.00	.00	1.	2.
3630.	76.50	.00	.00	.00	0.	.01	.00	.00	1.	2.
3980.	83.88	.00	.00	.00	0.	.00	.00	.00	0.	2.
4360.	91.87	.00	.00	.00	0.	.00	.00	.00	0.	2.
4780.	100.74	.00	.00	.00	0.	.00	.00	.00	0.	2.
5240.	110.44	.00	.00	.00	0.	.00	.00	.00	0.	2.
5750.	121.19	.00	.00	.00	0.	.00	.00	.00	0.	2.
6300.	132.78	.00	.00	.00	0.	.00	.00	.00	0.	1.
6910.	145.63	.00	.00	.00	0.	.00	.00	.00	0.	1.
7580.	159.75	.00	.00	.00	0.	.00	.00	.00	0.	1.
8310.	175.16	.00	.00	.00	0.	.00	.00	.00	0.	1.
9120.	192.21	.00	.00	0.00	0.	.00	.00	0.00	0.	1.
10000.	210.76	.00	.00	0.00	0.	.00	.00	0.00	0.	1.

COMPUTER PROGRAM FOR PREDICTING CASUALTIES AND DAMAGE

FROM ACCIDENTAL EXPLOSIONS

Tables of Results

Technical Paper 11

Supplement

Department of Defense Explosives Safety Board

Washington, D. C.

May 1975

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COMPUTER PROGRAM FOR PREDICTING CASUALTIES
AND DAMAGE FROM ACCIDENTAL EXPLOSIONS

Tables of Results

Numerical results tabulated on succeeding pages were calculated

by means of a computer program described in Department of Defense

Explosives Safety Board Technical Paper 11, of which this is a

supplement. The program generates tables of injury probability,

percent casualties, and percent damage to residential buildings as

functions of distance from block stacks of mass-detonating bombs and

projectiles described in the input data.

Results are presented for aboveground stacks of the following

four weapons: 500-lb bomb Mark 82, H-6 loaded; 750-lb bomb M117,

tritonal loaded; 155-mm projectile M107, TNT loaded; and 175-mm

projectile M437A2, Composition B loaded. The stacks considered are

assumed to be built up of weapons strapped to their normal shipping

pallets, and range from approximately 5,000 to 500,000 lb in net

explosive content. In these configurations, the bombs are stored with

axes horizontal, while the projectiles are stored with bases down.

The scaled distance listed in the second column of each table is in

units of feet divided by the cube root of the equivalent weight, in

pounds, of uncased TNT.

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MARK 82   500000 LB HE AT 1.25 TNT EQ, 102 SIDE UNITS, EARTH COVER 0, STACK SHAPE 17 X 27 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.23	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	2.47	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	3.70	1.00	1.00	.99	100.	1.00	1.00	1.00	100.	100.
400.	4.93	1.00	1.00	.95	100.	1.00	1.00	1.00	100.	100.
500.	6.16	1.00	.88	.87	100.	1.00	1.00	1.00	100.	100.
600.	7.40	1.00	.08	.75	100.	1.00	.98	1.00	100.	100.
800.	9.86	1.00	.00	.47	100.	1.00	.80	.82	100.	100.
1000.	12.33	.10	.00	.25	33.	1.00	.52	.42	100.	95.
1200.	14.79	.00	.00	.12	12.	1.00	.29	.16	100.	72.
1500.	18.49	.00	.00	.03	3.	1.00	.11	.04	100.	40.
1800.	22.19	.00	.00	.01	1.	1.00	.04	.01	100.	33.
2300.	28.35	.00	.00	.00	0.	.62	.01	.00	62.	12.
2800.	34.51	.00	.00	.00	0.	.21	.00	.00	21.	8.
3500.	43.14	.00	.00	.00	0.	.06	.00	.00	6.	5.
4300.	53.00	.00	.00	.00	0.	.02	.00	.00	2.	3.
5300.	65.32	.00	.00	.00	0.	.01	.00	.00	1.	3.
6500.	80.11	.00	.00	.00	0.	.01	.00	.00	1.	2.
8100.	99.83	.00	.00	.00	0.	.01	.00	.00	1.	2.
10000.	123.25	.00	.00	0.00	0.	.00	.00	0.00	0.	2.

MARK 82   250000 LB HE AT 1.25 TNT EQ, 78 SIDE UNITS, EARTH COVER 0, STACK SHAPE 13 X 18 X 6

| DIST (FT) | SCALED DIST | PROBABILITIES OF SEVERE OR FATAL INJURY | | | PERCENT SERIOUS INJURY OR DEATH | PROBABILITIES OF ANY INJURY OR FATALITY | | | PERCENT ANY INJURY OR DEATH | PERCENT BUILDING DAMAGE |
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.55	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	3.11	1.00	1.00	.99	100.	1.00	1.00	1.00	100.	100.
300.	4.66	1.00	1.00	.97	100.	1.00	1.00	1.00	100.	100.
400.	6.21	1.00	.85	.90	100.	1.00	1.00	1.00	100.	100.
500.	7.76	1.00	.02	.79	100.	1.00	.96	1.00	100.	100.
600.	9.32	.99	.00	.65	100.	1.00	.85	.98	100.	100.
800.	12.42	.00	.00	.38	38.	1.00	.51	.73	100.	94.
1000.	15.53	.00	.00	.20	20.	1.00	.24	.34	100.	65.
1200.	18.63	.00	.00	.09	9.	1.00	.11	.12	100.	39.
1500.	23.29	.00	.00	.03	3.	.86	.03	.03	87.	20.
1800.	27.95	.00	.00	.01	1.	.40	.01	.01	42.	12.
2300.	35.72	.00	.00	.00	0.	.09	.00	.00	10.	7.
2800.	43.48	.00	.00	.00	0.	.03	.00	.00	3.	5.
3500.	54.55	.00	.00	.00	0.	.01	.00	.00	1.	3.
4300.	66.77	.00	.00	.00	0.	.01	.01	.00	1.	3.
5300.	82.30	.00	.00	.00	0.	.01	.00	.00	1.	2.
6500.	100.94	.00	.00	.00	0.	.00	.00	.00	0.	2.
8100.	125.78	.00	.00	.00	0.	.00	.00	.00	0.	2.
10000.	155.29	.00	.00	0.00	0.	.00	.00	0.00	0.	1.

MARK 82   100000 LB HE AT 1.25 TNT EQ, 48 SIDE UNITS, EARTH COVER 0, STACK SHAPE 8 X 12 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.11	1.00	1.00	.99	100.	1.00	1.00	1.00	100.	100.
200.	4.22	1.00	1.00	.96	100.	1.00	1.00	1.00	100.	100.
300.	6.32	1.00	.76	.88	100.	1.00	1.00	1.00	100.	100.
400.	8.43	.95	.00	.76	99.	1.00	.92	1.00	100.	100.
500.	10.54	.01	.00	.62	62.	1.00	.72	.99	100.	100.
600.	12.65	.00	.00	.48	48.	1.00	.49	.92	100.	95.
800.	16.86	.00	.00	.26	26.	1.00	.17	.55	100.	52.
1000.	21.08	.00	.00	.13	13.	.79	.06	.22	85.	27.
1200.	25.29	.00	.00	.06	6.	.34	.02	.08	40.	16.
1500.	31.61	.00	.00	.02	2.	.09	.00	.02	11.	9.
1800.	37.94	.00	.00	.00	0.	.03	.00	.01	4.	6.
2300.	48.47	.00	.00	.00	0.	.01	.00	.00	1.	4.
2800.	59.01	.00	.00	.00	0.	.01	.00	.00	1.	3.
3500.	73.76	.00	.00	.00	0.	.01	.00	.00	1.	2.
4300.	90.62	.00	.00	.00	0.	.00	.00	.00	0.	2.
5300.	111.70	.00	.00	.00	0.	.00	.00	.00	0.	2.
6500.	136.99	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	170.71	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	210.76	.00	.00	0.00	0.	.00	.00	0.00	0.	1.

MARK 82   50000 LB HE AT 1.25 TNT EQ,   30 SIDE UNITS, EARTH COVER 0, STACK SHAPE 5 X 9 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.66	1.00	1.00	.95	100.	1.00	1.00	1.00	100.	100.
200.	5.31	1.00	1.00	.86	100.	1.00	1.00	1.00	100.	100.
300.	7.97	.75	.00	.74	94.	1.00	.95	1.00	100.	100.
400.	10.62	.00	.00	.59	59.	1.00	.71	.99	100.	100.
500.	13.28	.00	.00	.45	45.	1.00	.42	.94	100.	88.
600.	15.93	.00	.00	.34	34.	1.00	.22	.79	100.	61.
800.	21.24	.00	.00	.17	17.	.51	.05	.39	72.	26.
1000.	26.55	.00	.00	.08	8.	.14	.01	.15	27.	14.
1200.	31.86	.00	.00	.04	4.	.05	.00	.05	10.	9.
1500.	39.83	.00	.00	.01	1.	.02	.00	.01	3.	6.
1800.	47.80	.00	.00	.00	0.	.01	.00	.00	1.	4.
2300.	61.07	.00	.00	.00	0.	.01	.00	.00	1.	3.
2800.	74.35	.00	.00	.00	0.	.00	.00	.00	1.	2.
3500.	92.94	.00	.00	.00	0.	.00	.00	.00	0.	2.
4300.	114.18	.00	.00	.00	0.	.00	.00	.00	0.	2.
5300.	140.73	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	172.60	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	215.08	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	265.54	.00	.00	0.00	0.	.00	.00	0.00	0.	1.

MARK 82   25000 LB HE AT 1.25 TNT EQ, 24 SIDE UNITS, EARTH COVER 0, STACK SHAPE 4 X 6 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	3.35	1.00	1.00	.90	100.	1.00	1.00	1.00	100.	100.
200.	6.69	.99	.38	.79	100.	1.00	.99	1.00	100.	100.
300.	10.04	.00	.00	.65	65.	1.00	.78	1.00	100.	100.
400.	13.38	.00	.00	.51	51.	1.00	.41	.98	100.	87.
500.	16.73	.00	.00	.38	38.	.66	.18	.89	99.	53.
600.	20.07	.00	.00	.28	28.	.40	.07	.71	84.	31.
800.	26.76	.00	.00	.14	14.	.07	.01	.33	39.	14.
1000.	33.46	1.00	.00	.07	7.	.02	.00	.12	14.	8.
1200.	40.15	.00	.00	.03	3.	.01	.00	.04	5.	6.
1500.	50.18	.00	.00	.01	1.	.01	.00	.01	2.	4.
1600.	60.22	.00	.00	.00	0.	.01	.00	.00	1.	3.
2300.	76.95	.00	.00	.00	0.	.00	.00	.00	0.	2.
2800.	93.68	.00	.00	.00	0.	.00	.00	.00	0.	2.
3500.	117.09	.00	.00	.00	0.	.00	.00	.00	0.	2.
4300.	143.86	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	177.31	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	217.46	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	270.99	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	334.55	.00	0.00	0.00	0.	.00	.00	0.00	0.	1.

MARK 82   10000 LB HE AT 1.25 TNT EQ, 18 SIDE UNITS, EARTH COVER 0, STACK SHAPE 3 X 3 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	4.54	1.00	1.00	.83	100.	1.00	1.00	1.00	100.	100.
200.	9.08	.00	.00	.69	69.	1.00	.87	1.00	100.	100.
300.	13.62	.00	.00	.55	55.	.96	.39	.99	100.	84.
400.	18.16	.00	.00	.42	42.	.34	.12	.95	97.	42.
500.	22.70	.00	.00	.30	30.	.09	.04	.81	83.	22.
600.	27.24	.00	.00	.22	22.	.03	.01	.61	63.	13.
800.	36.32	.00	.00	.11	11.	.01	.00	.26	27.	7.
1000.	45.41	.00	.00	.05	5.	.01	.00	.09	10.	4.
1200.	54.49	.00	.00	.02	2.	.01	.00	.03	4.	3.
1500.	68.11	.00	.00	.01	1.	.00	.00	.01	1.	3.
1800.	81.73	.00	.00	.00	0.	.00	.00	.00	1.	2.
2300.	104.43	.00	.00	.00	0.	.00	.00	.00	0.	2.
2800.	127.14	.00	.00	.00	0.	.00	.00	.00	0.	2.
3500.	158.92	.00	.00	.00	0.	.00	.00	.00	0.	1.
4300.	195.25	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	240.65	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	295.14	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	567.79	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	454.06	.00	.00	0.00	0.	.00	.00	0.00	0.	1.

MARK 82   5000 LB HE AT 1.25 TNT EQ,   8 SIDE UNITS, EARTH COVER 0, STACK SHAPE 2 X 3 X 4

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	5.72	.76	.94	.54	99.	1.00	1.00	1.00	100.	100.
200.	11.44	.00	.00	.41	41.	1.00	.62	.98	100.	99.
300.	17.16	.00	.00	.30	30.	.26	.16	.90	94.	49.
400.	22.88	.00	.00	.21	21.	.05	.04	.73	75.	21.
500.	28.60	.00	.00	.15	15.	.02	.01	.52	54.	12.
600.	34.32	.00	.00	.10	10.	.01	.00	.34	35.	8.
800.	45.77	.00	.00	.05	5.	.01	.00	.12	13.	4.
1000.	57.21	.00	.00	.02	2.	.00	.00	.04	5.	3.
1200.	68.65	.00	.00	.01	1.	.00	.00	.01	2.	5.
1500.	85.81	.00	.00	.00	0.	.00	.00	.00	1.	2.
1800.	102.97	.00	.00	.00	0.	.00	.00	.00	0.	2.
2300.	131.58	.00	.00	.00	0.	.00	.00	.00	0.	1.
2800.	160.18	.00	.00	.00	0.	.00	.00	.00	0.	1.
3500.	200.23	.00	.00	.00	0.	.00	.00	.00	0.	1.
4300.	245.99	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	303.20	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	371.85	.00	.00	0.00	0.	.00	.00	.00	0.	1.
8100.	463.38	.00	.00	0.00	0.	.00	.00	.00	0.	1.
10000.	572.08	.00	.00	0.00	0.	.00	.00	0.00	0.	1.

M117   500000 LB HE AT 1.13 TNT EQ, 36 SIDE UNITS, EARTH COVER 0, STACK SHAPE 12 X 36 X 3

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.25	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	2.50	1.00	1.00	.99	100.	1.00	1.00	1.00	100.	100.
300.	3.75	1.00	1.00	.95	100.	1.00	1.00	1.00	100.	100.
400.	5.00	1.00	1.00	.83	100.	1.00	1.00	1.00	100.	100.
500.	6.26	1.00	.84	.64	100.	1.00	1.00	1.00	100.	100.
600.	7.51	1.00	.06	.45	100.	1.00	.97	.99	100.	100.
800.	10.01	1.00	.00	.19	100.	1.00	.78	.80	100.	100.
1000.	12.51	.05	.00	.07	12.	1.00	.50	.43	100.	94.
1200.	15.01	.00	.00	.05	6.	1.00	.28	.18	100.	70.
1500.	18.77	.00	.00	.03	3.	1.00	.11	.04	100.	38.
1800.	22.52	.00	.00	.02	2.	.99	.04	.03	99.	22.
2300.	28.77	.00	.00	.01	1.	.56	.01	.01	57.	11.
2800.	35.03	.00	.00	.00	0.	.18	.00	.01	19.	7.
3500.	45.79	.00	.00	.00	0.	.05	.00	.00	5.	5.
4300.	53.79	.00	.00	.00	0.	.02	.00	.00	2.	3.
5300.	66.30	.00	.00	.00	0.	.01	.00	.00	1.	3.
6500.	81.32	.00	.00	.00	0.	.01	.00	.00	1.	2.
8100.	101.33	.00	.00	.00	0.	.01	.00	.00	1.	2.
10000.	125.10	.00	.00	.00	0.	.00	.00	.00	0.	2.

M117   250000 LB HE AT 1.15 TNT EQ, 27 SIDE UNITS, EARTH COVER 0, STACK SHAPE 9 X 24 X 3

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.58	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	3.15	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
300.	4.73	1.00	1.00	.90	100.	1.00	1.00	1.00	100.	100.
400.	6.30	1.00	.79	.74	100.	1.00	1.00	1.00	100.	100.
500.	7.88	1.00	.01	.54	100.	1.00	.95	1.00	100.	100.
600.	9.46	.97	.00	.36	98.	1.00	.84	.97	100.	100.
800.	12.61	.00	.00	.14	14.	1.00	.49	.70	100.	93.
1000.	15.76	.00	.00	.06	6.	1.00	.23	.35	100.	62.
1200.	18.91	.00	.00	.04	4.	1.00	.10	.14	100.	37.
1500.	23.64	.00	.00	.03	3.	.81	.03	.03	82.	19.
1600.	28.37	.00	.00	.02	2.	.36	.01	.02	38.	12.
2300.	36.25	.00	.00	.01	1.	.08	.00	.01	9.	7.
2800.	44.13	.00	.00	.00	0.	.03	.00	.00	3.	5.
3500.	55.17	.00	.00	.00	0.	.01	.00	.00	1.	3.
4300.	67.18	.00	.00	.00	0.	.01	.00	.00	1.	3.
5300.	83.54	.00	.00	.00	0.	.01	.00	.00	1.	2.
6500.	102.45	.00	.00	.00	0.	.00	.00	.00	0.	2.
8100.	127.67	.00	.00	.00	0.	.00	.00	.00	0.	2.
10000.	157.62	.00	.00	.00	0.	.00	.00	.00	0.	1.

T-9

M117 100000 LB HE AT 1.15 TNT EQ, 15 SIDE UNITS, EARTH COVER 0, STACK SHAPE 5 X 18 X 3

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.14	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
200.	4.28	1.00	1.00	.89	100.	1.00	1.00	1.00	100.	100.
300.	6.42	1.00	.68	.72	100.	1.00	1.00	1.00	100.	100.
400.	8.56	.98	.00	.52	94.	1.00	.9?	1.00	100.	100.
500.	10.70	.00	.00	.35	35.	1.00	.71	.96	100.	100.
600.	12.84	.00	.00	.22	22.	1.00	.47	.86	100.	100.
800.	17.21	.00	.00	.08	8.	1.00	.16	.49	100.	91.
1000.	21.39	.00	.00	.03	5.	.74	.05	.21	80.	50.
1200.	25.67	.00	.00	.02	2.	.30	.02	.08	36.	26.
1500.	32.09	.00	.00	.01	1.	.08	.00	.04	10.	15.
1800.	38.51	.00	.00	.01	1.	.03	.00	.01	4.	9.
2300.	49.20	.00	.00	.00	0.	.01	.00	.00	2.	6.
2800.	59.90	.00	.00	.00	0.	.01	.00	.00	1.	4.
3500.	74.67	.00	.00	.00	0.	.00	.00	.00	1.	3.
4300.	91.99	.00	.00	.00	0.	.00	.00	.00	0.	2.
5300.	113.38	.00	.00	.00	0.	.00	.00	.00	0.	2.
6500.	139.05	.00	.00	.00	0.	.00	.00	.00	0.	2.
8100.	173.28	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	213.92	.00	.00	.00	0.	.00	.00	.00	0.	1.

M117   50000 LB HE AT 1.13 TNT EQ, 12 SIDE UNITS, EARTH COVER 0, STACK SHAPE 4 X 12 X 3

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY		PROBABILITIES OF FATAL INJURY	PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.70	1.00	1.00	.95	100.	1.00	1.00	1.00	100.	100.
200.	5.39	1.00	1.00	.82	100.	1.00	1.00	1.00	100.	100.
300.	8.09	.00	.00	.64	85.	1.00	.94	1.00	100.	100.
400.	10.78	.00	.00	.45	45.	1.00	.70	.99	100.	100.
500.	13.48	.00	.00	.29	29.	1.00	.40	.93	100.	86.
600.	16.17	.00	.00	.18	18.	.99	.21	.79	100.	58.
800.	21.56	.00	.00	.07	7.	.46	.05	.42	70.	25.
1000.	26.95	.00	.00	.03	3.	.12	.01	.17	28.	14.
1200.	32.34	.00	.00	.02	2.	.04	.00	.06	11.	9.
1500.	40.43	.00	.00	.01	1.	.02	.00	.02	5.	5.
1800.	48.51	.00	.00	.01	>.	.01	.01	.01	2.	4.
2300.	61.99	.00	.00	.00	0.	.01	.01	.00	1.	3.
2800.	75.47	.00	.00	.00	0.	.00	.00	.00	1.	2.
3500.	94.33	.00	.00	.00	0.	.00	.00	.00	0.	2.
4300.	115.90	.00	.00	.00	0.	.00	.00	.00	0.	2.
5300.	142.85	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	175.19	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	218.52	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	269.53	.00	.00	.00	0.	.00	.00	.00	0.	1.

M117   25000 LB HE AT 1.15 TNT EQ,   9 SIDE UNITS, EARTH COVER 0, STACK SHAPE 3 X 8 X 3

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	3.40	1.00	1.00	.89	100.	1.00	1.00	1.00	100.	100.
200.	6.79	.97	.30	.73	99.	1.00	.99	1.00	100.	100.
300.	10.19	.00	.00	.53	53.	1.00	.76	1.00	100.	100.
400.	13.58	.00	.00	.36	36.	1.00	.39	.96	100.	85.
500.	16.98	.00	.00	.23	23.	.81	.17	.86	98.	51.
600.	20.37	.00	.00	.14	14.	.36	.07	.67	81.	30.
800.	27.17	.00	.00	.05	5.	.08	.01	.33	36.	13.
1000.	33.96	.00	.00	.02	2.	.02	.00	.13	15.	6.
1200.	40.75	.00	.00	.01	1.	.01	.00	.05	6.	5.
1500.	50.94	.00	.00	.01	1.	.01	.00	.01	3.	4.
1800.	61.12	.00	.00	.01	1.	.01	.00	.01	1.	3.
2300.	78.10	.00	.00	.00	0.	.00	.00	.00	1.	2.
2800.	95.08	.00	.00	.00	0.	.00	.00	.00	1.	2.
3500.	118.85	.00	.00	.00	0.	.00	.00	.00	0.	2.
4300.	146.02	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	179.98	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	220.73	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	275.06	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	339.54	.00	.00	.00	0.	.00	.00	.00	0.	1.

M117 10000 LB HE AT 1.13 TNT EQ, 4 SIDE UNITS, EARTH COVER 0, STACK SHAPE 2 X 6 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	4.61	1.00	1.00	.63	100.	1.00	1.00	1.00	100.	100.
200.	9.22	.00	.00	.44	44.	1.00	.96	.99	100.	100.
300.	13.83	.00	.00	.29	29.	.94	.37	.92	100.	82.
400.	18.44	.00	.00	.18	18.	.30	.12	.77	86.	40.
500.	23.04	.00	.00	.11	11.	.08	.03	.58	63.	21.
600.	27.65	.00	.00	.06	6.	.03	.01	.40	43.	13.
800.	36.87	.00	.00	.02	2.	.01	.00	.17	18.	7.
1000.	46.09	.00	.00	.01	1.	.01	.00	.06	7.	4.
1200.	55.31	.00	.00	.01	1.	.01	.00	.02	3.	3.
1500.	69.13	.00	.00	.00	0.	.01	.00	.01	1.	2.
1800.	82.96	.00	.00	.00	0.	.00	.00	.00	1.	2.
2300.	106.00	.00	.00	.00	0.	.00	.00	.00	1.	2.
2800.	129.05	.00	.00	.00	0.	.00	.00	.00	0.	2.
3500.	161.51	.00	.00	.00	0.	.00	.00	.00	0.	1.
4300.	198.18	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	244.27	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	299.58	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	373.32	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	460.89	.00	.00	.00	0.	.00	.00	.00	0.	1.

M117   5000 LB HE AT 1.13 TNT EQ,   3 SIDE UNITS, EARTH COVER 0, STACK SHAPE 1 X 4 X 3

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	ANY INJURY OR BLAST INJURY	ALL FRAGMENTS		
100.	5.81	.60	.91	.52	98.	1.00	1.00	1.00	100.	100.
200.	11.61	.00	.00	.35	35.	.99	.60	.96	100.	98.
300.	17.42	.00	.00	.22	22.	.23	.13	.85	90.	47.
400.	23.23	.00	.00	.14	14.	.04	.03	.67	67.	20.
500.	29.03	.00	.00	.08	8.	.02	.01	.46	49.	21.
600.	34.64	.00	.00	.05	5.	.01	.00	.32	33.	7.
800.	46.45	.00	.00	.02	2.	.01	.00	.13	15.	6.
1000.	58.07	.00	.00	.01	1.	.00	.00	.05	5.	3.
1200.	69.68	.00	.00	.00	0.	.00	.00	.02	2.	2.
1500.	87.10	.00	.00	.00	0.	.00	.00	.00	1.	2.
1800.	104.52	.00	.00	.00	0.	.00	.00	.00	1.	2.
2300.	133.56	.00	.00	.00	0.	.00	.00	.00	0.	1.
2800.	162.59	.00	.00	.00	0.	.00	.00	.00	0.	1.
3500.	203.24	.00	.00	.00	0.	.00	.00	.00	0.	1.
4300.	249.69	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	307.76	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	377.44	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	470.35	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	580.68	.00	.00	.00	0.	.00	.00	.00	0.	1.

155 MM   500000 LB HE AT 1.00 TNT EQ, 256 SIDE UNITS, EARTH COVER 0, STACK SHAPE 128 X 128 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.38	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	2.76	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	4.14	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
400.	5.52	1.00	1.00	.93	100.	1.00	1.00	1.00	100.	100.
500.	6.89	1.00	.33	.71	100.	1.00	.99	1.00	100.	100.
600.	8.27	1.00	.00	.43	100.	1.00	.93	.94	100.	100.
800.	11.03	.43	.00	.36	63.	1.00	.67	.52	100.	99.
1000.	13.79	.09	.00	.29	29.	1.00	.37	.39	100.	83.
1200.	16.55	.00	.00	.23	23.	1.00	.19	.29	100.	55.
1500.	20.68	.00	.00	.16	16.	1.00	.06	.21	100.	29.
1800.	24.82	.00	.00	.12	12.	.83	.02	.15	86.	17.
2300.	31.72	.00	.00	.06	6.	.26	.00	.08	32.	9.
2800.	38.61	.00	.00	.03	3.	.08	.00	.04	12.	6.
3500.	48.26	.00	.00	.01	1.	.03	.00	.02	4.	4.
4300.	59.29	.00	.00	.01	1.	.01	.00	.01	2.	3.
5300.	74.08	.00	.00	.00	0.	.01	.00	.00	1.	2.
6500.	89.63	.00	.00	.00	0.	.01	.00	.00	1.	2.
8100.	111.69	.00	.00	.00	0.	.00	.00	.00	0.	2.
10000.	157.89	.00	.00	.00	0.	.00	.00	.00	0.	1.

T-15

155 MM   250000 LB HE AT 1.00 TNT EQ, 184 SIDE UNITS, EARTH COVER 0, STACK SHAPE 88 X 92 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.74	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	3.47	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	5.21	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
400.	6.95	1.00	1.00	.85	100.	1.00	.99	1.00	100.	100.
500.	8.69	1.00	1.00	.59	100.	1.00	.90	.98	100.	100.
600.	10.42	.17	.00	.34	45.	1.00	.74	.87	100.	100.
800.	13.90	.00	.00	.27	27.	1.00	.37	.41	100.	82.
1000.	17.37	.00	.00	.22	22.	1.00	.15	.30	100.	48.
1200.	20.85	.00	.00	.17	17.	.95	.64	.22	96.	28.
1500.	26.06	.00	.00	.12	12.	.45	.02	.15	55.	15.
1800.	31.27	.00	.00	.06	6.	.15	.00	.11	25.	9.
2300.	39.96	.00	.00	.05	5.	.04	.00	.06	10.	6.
2800.	48.65	.00	.00	.02	2.	.02	.00	.03	5.	4.
3500.	60.81	.00	.00	.01	1.	.01	.00	.01	2.	3.
4300.	74.71	.00	.00	.00	0.	.01	.00	.00	1.	2.
5300.	92.08	.00	.00	.00	0.	.00	.00	.00	1.	2.
6500.	112.93	.00	.00	.00	0.	.00	.00	.00	0.	2.
8100.	140.73	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	173.74	.00	.00	.00	0.	.00	.00	.00	0.	1.

155 MM   200000 LB HE AT 1.00 TNT EQ, 160 SIDE UNITS, EARTH COVER 0, STACK SHAPE 80 X 80 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.87	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	3.74	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	5.61	1.00	.99	.97	100.	1.00	1.00	1.00	100.	100.
400.	7.49	1.00	.05	.81	100.	1.00	.97	1.00	100.	100.
500.	9.36	.68	.00	.54	85.	1.00	.85	.97	100.	100.
600.	11.23	.00	.00	.30	30.	1.00	.64	.83	100.	99.
800.	14.97	.00	.00	.24	24.	1.00	.28	.37	100.	70.
1000.	18.72	.00	.00	.19	19.	.99	.11	.27	100.	38.
1200.	22.46	.00	.00	.15	15.	.76	.04	.19	81.	22.
1500.	28.07	.00	.30	.11	11.	.25	.01	.14	35.	12.
1800.	33.69	.00	.00	.07	7.	.08	.00	.09	17.	8.
2300.	43.04	.00	.00	.04	4.	.02	.00	.05	7.	5.
2800.	52.40	.00	.00	.02	2.	.01	.00	.03	4.	4.
3500.	65.50	.00	.00	.01	1.	.01	.00	.01	2.	3.
4300.	80.48	.00	.00	.00	0.	.01	.00	.00	1.	2.
5300.	99.19	.00	.00	.00	0.	.00	.00	.00	1.	2.
6500.	121.65	.00	.00	.00	0.	.00	.00	.20	0.	2.
8100.	151.59	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	187.15	.00	.00	.00	0.	.00	.00	.00	0.	1.

155 MM   100000 LB HE AT 1.00 TNT EQ, 116 SIDE UNITS, EARTH COVER 0, STACK SHAPE 56 X 56 X 6

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY		PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF FATAL INJURY	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE		HEAVY FRAGMENTS	GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.36	1.00	1.00	100.	1.00	1.00	1.00	1.00	100.	100.
200.	4.72	1.00	1.00	100.	1.00	1.00	1.00	1.00	100.	100.
300.	7.07	1.00	.18	100.	.92	1.00	.99	1.00	100.	100.
400.	9.43	.07	.00	72.	.70	1.00	.84	.99	100.	100.
500.	11.79	.00	.00	43.	.43	1.00	.58	.92	100.	97.
600.	14.15	.00	.00	23.	.23	1.00	.34	.73	100.	79.
800.	18.86	.00	.00	16.	.18	.91	.10	.28	94.	38.
1000.	23.58	.00	.00	14.	.14	.38	.03	.20	52.	20.
1200.	28.30	.00	.00	11.	.11	.13	.01	.14	26.	12.
1500.	35.37	.00	.00	8.	.08	.04	.00	.10	13.	7.
1800.	42.44	.00	.00	5.	.05	.02	.00	.07	9.	5.
2300.	54.23	.00	.00	3.	.03	.01	.00	.04	5.	3.
2800.	66.02	.00	.00	2.	.02	.01	.00	.02	3.	3.
3500.	82.53	.00	.00	1.	.01	.00	.00	.01	1.	2.
4300.	101.39	.00	.00	0.	.00	.00	.00	.00	1.	2.
5300.	124.97	.00	.00	0.	.00	.00	.00	.00	0.	2.
6500.	153.27	.00	.00	0.	.00	.00	.00	.00	0.	1.
8100.	190.99	.00	.00	0.	.00	.00	.00	.00	0.	1.
10700.	235.80	.00	.00	0.	.00	.00	.00	.00	0.	1.

155 MM   50000 LB HE AT 1.00 TNT EQ, 80 SIDE UNITS, EARTH COVER 0, STACK SHAPE 40 X 40 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY		PROBABILITIES OF FATAL INJURY	PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.97	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	5.94	1.00	.93	.98	100.	1.00	1.00	1.00	100.	100.
300.	8.91	.02	.00	.83	85.	1.00	.89	1.00	100.	100.
400.	11.88	.00	.00	.56	56.	1.00	.57	.97	100.	97.
500.	14.85	.00	.00	.32	32.	1.00	.29	.83	100.	72.
600.	17.83	.00	.00	.16	16.	.83	.14	.59	94.	44.
800.	23.77	.00	.00	.13	13.	.20	.03	.21	38.	19.
1000.	29.71	.00	.00	.10	10.	.05	.01	.14	20.	11.
1200.	35.65	.00	.00	.08	6.	.02	.00	.10	12.	7.
1500.	44.56	.00	.00	.05	5.	.01	.00	.07	8.	5.
1800.	53.48	.00	.00	.04	4.	.01	.00	.05	4.	3.
2300.	68.33	.00	.00	.02	2.	.01	.00	.03	3.	3.
2800.	83.18	.00	.00	.01	1.	.00	.00	.01	2.	2.
3500.	103.98	.00	.00	.00	0.	.00	.00	.01	1.	2.
4300.	127.75	.00	.00	.00	0.	.00	.00	.00	1.	2.
5300.	157.45	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	193.10	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	240.64	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	297.08	.00	.00	.00	0.	.00	.00	.00	0.	1.

155 MM   25000 LB HE AT 1.00 TNT EQ, 60 SIDE UNITS, EARTH COVER 0, STACK SHAPE 30 X 28 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	3.74	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	7.49	.17	.03	.94	95.	1.00	.97	1.00	100.	100.
300.	11.23	.00	.00	.74	74.	1.00	.64	.99	100.	99.
400.	14.97	.00	.00	.46	46.	.95	.28	.93	100.	70.
500.	18.72	.00	.00	.25	25.	.46	.11	.74	87.	38.
600.	22.46	.00	.00	.13	13.	.15	.04	.49	59.	22.
800.	29.94	.00	.00	.10	10.	.03	.01	.16	19.	10.
1000.	37.43	.00	.00	.08	8.	.01	.00	.11	12.	6.
1200.	44.92	.00	.00	.06	6.	.01	.00	.08	8.	5.
1500.	56.15	.00	.00	.04	4.	.01	.00	.05	6.	3.
1800.	67.37	.00	.00	.03	3.	.00	.00	.04	4.	3.
2300.	86.09	.00	.00	.02	2.	.00	.00	.02	2.	2.
2800.	104.80	.00	.00	.01	1.	.00	.00	.01	1.	2.
3500.	131.01	.00	.00	.00	0.	.00	.00	.00	1.	1.
4300.	160.95	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	198.58	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	243.50	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	303.19	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	374.50	.00	.00	.00	0.	.00	.00	.00	0.	1.

T-20

155 MM   10000 LB HE AT 1.00 TNT EQ, 40 SIDE UNITS, EARTH COVER 0, STACK SHAPE 20 X 16 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	5.08	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
200.	10.16	.00	.00	.85	85.	1.00	.77	1.00	100.	100.
300.	15.24	.00	.00	.59	59.	.65	.26	.97	99.	68.
400.	20.32	.00	.00	.34	34.	.13	.07	.83	86.	30.
500.	25.40	.00	.00	.17	17.	.04	.02	.59	61.	16.
600.	30.48	.00	.00	.09	9.	.02	.01	.36	38.	10.
800.	40.64	.00	.00	.07	7.	.01	.00	.11	12.	5.
1000.	50.80	.00	.00	.05	5.	.01	.00	.08	8.	4.
1200.	60.96	.00	.00	.04	4.	.00	.00	.05	6.	3.
1500.	76.20	.00	.00	.03	3.	.00	.00	.04	4.	2.
1800.	91.44	.00	.00	.02	2.	.00	.00	.02	3.	2.
2300.	116.84	.00	.00	.01	1.	.00	.00	.01	2.	2.
2800.	142.24	.00	.00	.01	1.	.00	.00	.01	1.	1.
3500.	177.80	.00	.00	.00	0.	.00	.00	.00	1.	1.
4300.	218.44	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	269.24	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	330.20	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	411.49	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	508.01	.00	.00	.00	0.	.00	.00	.00	0.	1.

155 MM   5000 LB HE AT 1.00 TNT EQ, 28 SIDE UNITS, EARTH COVER 0, STACK SHAPE 14 X 12 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	6.40	.02	.45	.94	97.	1.00	1.00	1.00	100.	100.
200.	12.80	.00	.00	.74	74.	.63	.47	.99	100.	92.
300.	19.20	.00	.00	.46	46.	.10	.09	.91	93.	36.
400.	25.60	.00	.00	.25	25.	.02	.02	.71	72.	16.
500.	32.00	.00	.00	.13	13.	.01	.00	.46	47.	9.
600.	38.40	.00	.00	.06	4.	.01	.00	.27	28.	6.
800.	51.20	.00	.00	.05	5.	.00	.00	.08	8.	4.
1000.	64.00	.00	.00	.04	4.	.00	.00	.05	6.	3.
1200.	76.81	.00	.00	.03	3.	.00	.00	.04	4.	2.
1500.	96.01	.00	.00	.02	2.	.00	.00	.03	3.	2.
1800.	115.21	.00	.00	.01	1.	.00	.00	.02	2.	2.
2300.	147.21	.00	.00	.01	1.	.00	.00	.01	1.	1.
2800.	179.21	.00	.00	.00	0.	.00	.00	.00	1.	1.
3500.	224.02	.00	.00	.00	0.	.00	.00	.00	1.	1.
4300.	275.22	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	339.23	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	416.03	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	518.44	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	640.05	.00	.00	.00	0	.00	.00	.00	0.	1.

175 MM   500000 LB HE AT 1.10 TNT EQ, 188 SIDE UNITS, EARTH COVER 0, STACK SHAPE 94 X 87 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY		HEAVY FRAGMENTS	PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE			GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.33	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	2.65	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	3.98	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
400.	5.30	1.00	1.00	.98	100.	1.00	1.00	1.00	100.	100.
500.	6.63	1.00	.56	.86	100.	1.00	1.00	1.00	100.	100.
600.	7.95	1.00	.01	.59	100.	1.00	.93	.97	100.	100.
800.	10.60	.84	.00	.30	89.	1.00	.72	.63	100.	88.
1000.	13.25	.00	.00	.23	23.	1.00	.42	.34	100.	61.
1200.	15.90	.00	.00	.18	16.	1.00	.22	.22	100.	32.
1500.	19.88	.00	.00	.12	12.	1.00	.08	.15	100.	19.
1800.	23.85	.00	.00	.07	7.	.93	.03	.09	94.	10.
2300.	30.48	.00	.00	.04	4.	.36	.01	.05	40.	10.
2800.	37.10	.00	.00	.02	2.	.11	.00	.02	13.	6.
3500.	46.38	.00	.00	.01	1.	.03	.00	.01	4.	4.
4300.	56.98	.00	.00	.00	0.	.01	.00	.00	2.	3.
5300.	70.23	.00	.00	.00	0.	.01	.00	.00	1.	2.
6500.	86.13	.00	.00	.00	0.	.01	.00	.00	1.	2.
8100.	107.34	.00	.00	.00	0.	.00	.00	.00	0.	2.
10000.	142.51	.00	.00	.00	0.	.00	.00	.00	0.	1.

175 MM   250000 LB HE AT 1.10 TNT EQ, 132 SIDE UNITS, EARTH COVER 0, STACK SHA   62 X 66 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.67	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	3.34	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	5.01	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
400.	6.68	1.00	.49	.95	100.	1.00	1.00	1.00	100.	100.
500.	8.55	1.00	.00	.74	100.	1.00	.93	.99	100.	100.
600.	10.02	.54	.00	.47	75.	1.00	.78	.91	100.	100.
800.	13.36	.00	.00	.22	22.	1.00	.41	.50	100.	100.
1000.	16.70	.00	.00	.17	17.	1.00	.12	.25	100.	87.
1200.	20.03	.00	.00	.13	13.	.99	.08	.16	99.	53.
1500.	25.04	.00	.00	.08	8.	.60	.02	.11	65.	31.
1800.	30.05	.00	.00	.05	5.	.22	.01	.07	28.	17.
2300.	38.40	.00	.00	.02	2.	.05	.00	.03	8.	10.
2800.	46.75	.00	.00	.01	1.	.02	.00	.01	4.	6.
3500.	58.43	.00	.00	.00	0.	.01	.00	.01	2.	4.
4300.	71.79	.00	.00	.00	0.	.01	.00	.00	1.	3.
5300.	88.49	.00	.00	.00	0.	.01	.00	.00	1.	2.
6500.	108.52	.00	.00	.00	0.	.00	.00	.00	0.	2.
8100.	135.23	.00	.00	.00	0.	.00	.00	.00	0.	2.
10000.	166.96	.00	.00	.00	0.	.00	.00	.00	0.	1.

200000 LB HE AT 1.10 TNT EQ, 120 SIDE UNITS, EARTH COVER 0, STACK SHAPE 54 X 60 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF FATALITY ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	1.80	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	3.60	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	5.40	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
400.	7.19	1.00	.14	.95	100.	1.00	.92	1.00	100.	100.
500.	8.99	.96	.00	.71	99.	1.00	.88	.98	100.	100.
600.	10.79	.04	.00	.44	46.	1.00	.69	.89	100.	100.
800.	14.39	.00	.00	.20	20.	1.00	.32	.47	100.	77.
1000.	17.98	.00	.00	.16	16.	1.00	.13	.23	100.	43.
1200.	21.58	.00	.00	.12	12.	.88	.05	.15	90.	25.
1500.	26.98	.00	.00	.08	8.	.34	.01	.10	42.	14.
1800.	32.37	.00	.00	.05	5.	.11	.00	.06	17.	9.
2300.	41.37	.00	.00	.02	2.	.03	.00	.03	6.	5.
2800.	50.36	.00	.00	.01	1.	.01	.00	.01	3.	4.
3500.	62.95	.00	.00	.00	0.	.01	.00	.00	1.	3.
4300.	77.33	.00	.00	.00	0.	.01	.00	.00	1.	2.
5300.	95.32	.00	.00	.00	0.	.00	.00	.00	0.	2.
6500.	116.90	.00	.00	.00	0.	.00	.00	.00	0.	2.
8100.	145.68	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	179.85	.00	.00	.00	0.	.00	.00	.00	0.	1.

1/5 MH   100000 LB HE AT 1.10 TNT EQ, 84 SIDE UNITS, EARTH COVER 0, STACK SHAPE 40 X 82 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.27	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	4.53	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
300.	6.80	1.00	.36	.98	100.	1.00	.99	1.00	100.	100.
400.	9.06	.31	.00	.65	89.	1.00	.87	.99	100.	100.
500.	11.33	.00	.00	.58	58.	1.00	.63	.94	100.	99.
600.	13.60	.00	.00	.33	33.	1.00	.39	.78	100.	85.
800.	18.13	.00	.00	.15	15.	.97	.12	.36	99.	42.
1000.	22.66	.00	.00	.11	11.	.52	.04	.17	61.	22.
1200.	27.19	.00	.00	.08	6.	.18	.01	.11	28.	13.
1500.	33.99	.00	.00	.05	5.	.05	.00	.07	12.	8.
1800.	40.79	.00	.00	.03	3.	.02	.00	.04	6.	5.
2300.	52.12	.00	.00	.02	2.	.01	.00	.02	3.	4.
2800.	63.45	.00	.00	.01	1.	.01	.00	.01	2.	3.
3500.	79.51	.00	.00	.00	0.	.01	.00	.00	1.	2.
4300.	97.44	.00	.00	.00	0.	.00	.00	.00	1.	2.
5400.	120.10	.00	.00	.00	0.	.00	.00	.00	0.	2.
6500.	147.29	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	183.54	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	226.59	.00	.00	.00	0.	.00	.00	.00	0.	1.

175 MM   50000 LB HE AT 1.10 TNT EQ, 60 SIDE UNITS, EARTH COVER 0, STACK SHAPE 30 X 27 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	2.85	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	5.71	1.00	.98	1.00	100.	1.00	1.00	1.00	100.	100.
300.	8.56	.11	.00	.94	95.	1.00	.91	1.00	100.	100.
400.	11.42	.00	.00	.74	74.	1.00	.62	.98	100.	99.
500.	14.27	.00	.00	.46	46.	1.00	.33	.87	100.	78.
600.	17.13	.00	.00	.25	25.	.93	.16	.66	98.	50.
800.	22.84	.00	.00	.11	11.	.28	.04	.27	50.	21.
1000.	28.55	.00	.00	.08	8.	.07	.01	.12	20.	12.
1200.	34.26	.00	.00	.06	6.	.03	.00	.08	11.	8.
1500.	42.82	.00	.00	.04	4.	.01	.00	.05	6.	5.
1800.	51.39	.00	.00	.02	2.	.01	.00	.03	4.	4.
2300.	65.66	.00	.00	.01	1.	.01	.00	.01	2.	3.
2800.	79.94	.00	.00	.01	1.	.00	.00	.01	1.	2.
3500.	99.92	.00	.00	.00	0.	.00	.00	.00	1.	2.
4300.	122.76	.00	.00	.00	0.	.00	.00	.00	0.	2.
5300.	151.31	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	185.57	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	231.25	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	285.49	.00	.00	.00	0.	.00	.00	.00	0.	1.

175 MM 25000 LB HE AT 1.10 TNT EQ, 42 SIDE UNITS, EARTH COVER 0, STACK SHAPE 20 X 21 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	3.60	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	7.19	.54	.39	.99	99.	1.00	.98	1.00	100.	100.
300.	10.79	.00	.00	.87	87.	1.00	.69	.99	100.	100.
400.	14.39	.00	.00	.61	61.	.99	.32	.93	100.	77.
500.	17.98	.00	.00	.35	35.	.60	.13	.76	92.	43.
600.	21.58	.00	.00	.18	18.	.22	.05	.53	65.	25.
800.	28.78	.00	.00	.08	8.	.04	.01	.20	24.	11.
1000.	35.97	.00	.00	.06	6.	.02	.00	.09	11.	7.
1200.	43.16	.00	.00	.04	4.	.01	.00	.05	6.	5.
1500.	53.95	.00	.00	.03	3.	.01	.00	.03	4.	5.
1800.	64.75	.00	.00	.02	2.	.01	.00	.02	3.	3.
2300.	82.73	.00	.00	.01	1.	.00	.00	.01	1.	2.
2800.	100.72	.00	.00	.00	0.	.00	.00	.00	1.	2.
3500.	125.89	.00	.00	.00	0.	.00	.00	.00	1.	2.
4300.	154.67	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	190.64	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	233.60	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	291.35	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	359.70	.00	.00	.00	0.	.00	.00	.00	0.	1.

1/5 MM   10000 LH HE AT 1.10 TNT EQ, 28 SIDE UNITS, EARTH COVER 0, STACK SHAPE 14 X 12 X 2

		PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
DIST (FT)	SCALED DIST	HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	4.88	1.00	1.00	1.00	100.	1.00	1.00	1.00	100.	100.
200.	9.76	.00	.00	.94	94.	1.00	.81	1.00	100.	100.
300.	14.65	.00	.00	.74	74.	.79	.30	.96	99.	74.
400.	19.55	.00	.00	.46	46.	.18	.09	.82	87.	34.
500.	24.41	.00	.00	.25	25.	.05	.02	.61	64.	18.
600.	29.29	.00	.00	.13	13.	.02	.01	.40	42.	11.
800.	39.05	.00	.00	.05	5.	.01	.00	.14	15.	6.
1000.	48.82	.00	.00	.04	4.	.01	.00	.06	7.	4.
1200.	58.58	.00	.00	.03	3.	.00	.00	.04	4.	3.
1500.	73.26	.00	.00	.02	2.	.00	.00	.02	3.	2.
1800.	87.87	.00	.00	.01	1.	.00	.00	.01	2.	2.
2300.	112.28	.00	.00	.01	1.	.00	.00	.01	1.	2.
2800.	136.69	.00	.00	.00	0.	.00	.00	.00	1.	1.
3500.	170.86	.00	.00	.00	0.	.00	.00	.00	0.	1.
4300.	209.92	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	258.74	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	317.52	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	395.43	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	488.18	.00	.00	.00	0.	.00	.00	.00	0.	1.

1/5 MH   5000 LB HE AT 1.10 TNT EQ,   20 SIDE UNITS,   EARTH COVER 0,   STACK SHAPE 10 X 9 X 2

DIST (FT)	SCALED DIST	PROBABILITIES OF SEVERE OR FATAL INJURY			PERCENT SERIOUS INJURY OR DEATH	PROBABILITIES OF ANY INJURY OR FATALITY			PERCENT ANY INJURY OR DEATH	PERCENT BUILDING DAMAGE
		HEAD INJURY	LUNG COLLAPSE	HEAVY FRAGMENTS		GROUND IMPACT	BLAST INJURY	ALL FRAGMENTS		
100.	6.15	.11	.66	.99	100.	1.00	1.00	1.00	100.	100.
200.	12.30	.00	.00	.87	87.	.95	.52	.99	100.	95.
300.	18.45	.00	.00	.62	62.	.14	.11	.90	92.	40.
400.	24.60	.00	.00	.36	36.	.05	.02	.71	72.	17.
500.	30.75	.00	.00	.19	19.	.01	.01	.49	50.	10.
600.	36.90	.00	.00	.09	9.	.01	.00	.30	31.	7.
800.	49.21	.00	.00	.04	4.	.01	.00	.10	11.	4.
1000.	61.51	.00	.00	.03	3.	.00	.00	.04	5.	3.
1200.	73.81	.00	.00	.02	2.	.00	.00	.03	3.	2.
1500.	92.26	.00	.00	.01	1.	.00	.00	.02	2.	2.
1800.	110.71	.00	.00	.01	1.	.00	.00	.01	1.	2.
2300.	141.47	.00	.00	.00	0.	.00	.00	.00	1.	1.
2800.	172.22	.00	.00	.00	0.	.00	.00	.00	1.	1.
3500.	215.28	.00	.00	.00	0.	.00	.00	.00	0.	1.
4300.	264.48	.00	.00	.00	0.	.00	.00	.00	0.	1.
5300.	325.99	.00	.00	.00	0.	.00	.00	.00	0.	1.
6500.	399.80	.00	.00	.00	0.	.00	.00	.00	0.	1.
8100.	498.21	.00	.00	.00	0.	.00	.00	.00	0.	1.
10000.	615.07	.00	.00	.00	0.	.00	.00	.00	0.	1.